

COURTSHIP AND COPULATION IN *MYLLOCERUS*  
*UNDECIMPUSTULATUS MACULOSUS* DESB.  
(COLEOPTERA: CURCULIONIDAE)<sup>1</sup>

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(With two plates containing seven figures)

INTRODUCTION

Several aspects of the ethology of reproduction in Coleoptera are well documented in the families Buprestidae (Alcock 1976), Carabidae (Lorochelle 1973), Cicindelidae (Master 1976), Coccinellidae (Wang *et al.* 1977), Dermestidae (Barak and Burkholder 1977, Chaudhary and Kapil 1976 and Hammack *et al.* 1976), Hydrophilidae (Scheloske 1974), Lucanidae (Mathieu 1969), Meloidae (Selander 1964, Selander and Pinto 1967, Pinto 1972, 1974, 1975, 1977a and 1977b); Scarabaeidae (Bennett 1974, Halffter and Yrma 1977, Hardy 1976) and Staphylinidae (Peschke 1978). Though the family Curculionidae is a very large one and several species are economically important reproductive behaviour is known only in a few species, *Hylobius abietis* (Selander and Jansson 1977), *Microlarinus laevnii* (Kirkland and Geoden 1978) and *Anthonomus grandis* (Villavaso *et al.* 1975). Therefore an attempt, though preliminary in nature is made on the ethology of reproduction in the ash-weevil, *Myllocerus undecimpustulatus maculosus* Desb, which is Oriental in distribution. It is a polyphagous species and a serious pest on Cotton (*Gossypium barbadense* and *G. hirsutum*), Brinjal

(*Solanum melongena*) and other crops in India. The previous works on *M. maculosus* pertain to control measures (Krishan Kumar and Rattan Lal 1966); recording the host plants (Bhutani 1975) and unusual occurrence (Kareem *et al.* 1977) etc. are of preliminary nature only.

MATERIAL AND METHODS

Late instar grubs and pupae were brought from the fields and reared on cotton root in petri dishes. Newly emerged adults were released in pairs in glass jars to observe their courtship and mating. Fresh cotton leaves were provided as food for the adults. To avoid possible behavioural variability due to "learned" sexual behaviour, studies on courtship were performed on virgin adults.

The following different combinations of male and female were maintained separately to study the reaction of the adults in various mating types that exist under natural condition. (1) Newly emerged males and females, (2) Newly emerged males and unmated females of different ages (5-10 days after eclosion), (3) Newly emerged males and previously mated females, (4) Newly emerged females with previously unmated males, (5-10 days after eclosion), (5) Newly emerged females with previously mated males, (6) A few males along with more number of females, (7) Several males along with less number of females. The laboratory observations were compared with obser-

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ervations made in the field during September 1976 to December 1978.

Set up 1 shows the normal mating behaviour.

Set up 2 to 5 show the effect of age on mating response.

Set up 6 and 7 show the mating competition and aggression when one sex is predominant in a colony.

#### OBSERVATIONS AND RESULTS

##### *Normal mating (Mating type 1):*

Adults start mating 2-3 days after eclosion. When the male encounters the female, it instantaneously strikes the antennae of the female with its own antennae (Fig. 1). A receptive female remains motionless while an unreceptive female escapes with jerky movements. The male advances its fore legs and rubs the fore tarsi of the receptive female (Fig. 2) and the responding female reciprocates with a few antennal strokes on the attempting male. Then the male moves to the side of the female (Fig. 3) and with its fore legs rubs the pronotum of the female. This tactile stimulus rouses the female to raise the tip of its abdomen after disengaging the pygidium. Meanwhile, the male having released its aedeagus finds no resistance to establish genital connection (Fig. 4). The entire courtship does not extend beyond two minutes. Among virgin males and females the antennation and fore tarsal stimulation continues for 5-10 seconds. Once genital connection is achieved the male remains docile throughout and keep its antennae either straight or bent midway. The female, on the other hand, moves about dragging the male to suitable secluded places. Both males and females do not feed during copulation. When undisturbed the copulation lasts for 5-7 hours. Mating is quite common during early hours of the morning (05.00 hrs to 09.00 hrs). After copulation

the male and female move away and occasionally the males continue to pester by dorsal riding (Fig. 5). The various sequences involved in the courtship and copulation are shown diagrammatically in Fig. 7.

##### *Effect of age on mating response*

##### (Mating type 2):

Though the females are sexually active, they never initiate mating behaviour. Newly emerged males and virgin females behave in a similar fashion as described above, the females readily responding to the mating attempts initiated by the males. (Mating type 3): When newly emerged males are released among already mated females, the latter do not readily respond and, therefore, the pre-courtship behaviour is a bit more elaborate. Occasionally such females run away while the males persistently run after them and grab them with the fore legs and forcibly detain them by suddenly jumping upon them and lifting the posterior tip of the female's abdomen with their hind legs. An unreceptive female shakes off the male convulsively or only allows dorsal riding (Fig. 5) without separating the pygidium. But a virgin male persists in coaxing the female by gently drumming on the antennae and head of the female with its antennae, also frequently lifting the female's abdomen with its hind legs. When the female responds by straightening the abdominal segments and opening its genital aperture, the male secures genital connection while remaining on the dorsal side itself and releasing its aedeagus. Male releases its aedeagus only when the genital aperture of the female is opened and never in anticipation. This type of pre-courtship and dorsal riding by the male may last for more than 30 minutes. Occasionally, inspite of the coaxing of the male, the female remain unreceptive, dissection of such females show gravid



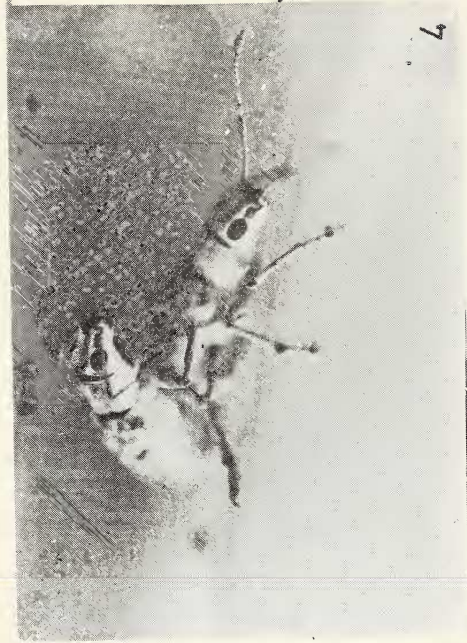
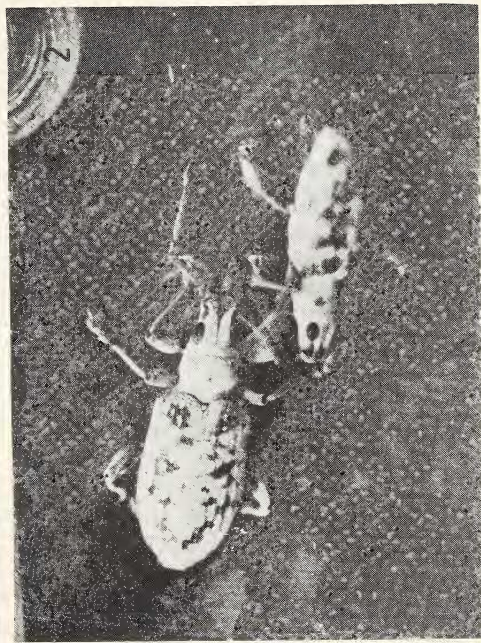


Fig. 1: Antennation. Fig. 2: Fore tarsi rubbing. Fig. 3: Male attaining lateral position to the female. Fig. 4: Copula position.  
(Photos: Author)



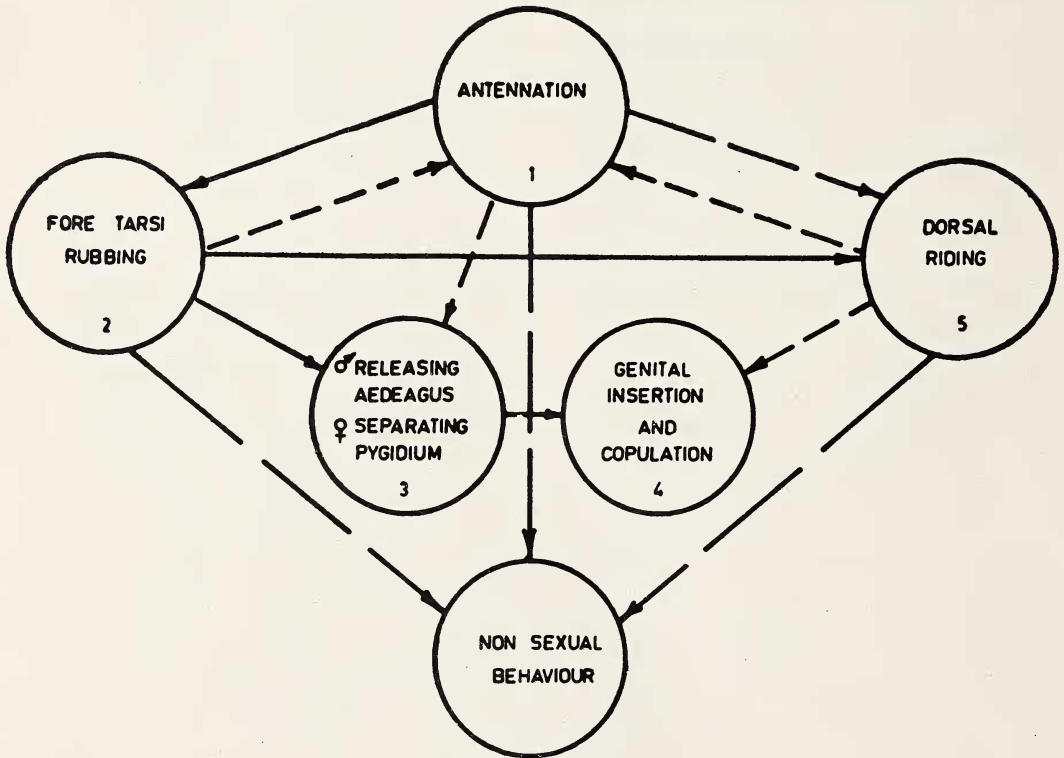


Fig. 5: Dorsal riding (without genital connection). Fig. 6: Intruding male attempting to sit in between copula pairs.

Fig. 7: Sequence diagram of mating in *M. maculosus*. (Numbers within the circle refer to figure number)

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ovarioles with already matured eggs. (Mating type 4): When newly emerged females are paired with aged as well as virgin males the latter start antennation and fore tarsal rubbing, but the newly emerged females never show any receptivity, either they run away or allow dorsal riding by the males and final separation. Aged and virgin males remain excited and aggressive as indicated by the forcible lifting of the posterior tip of female's abdomen and pulling by his fore legs and violently stopping her from running away. Occasionally the males suddenly jump on the other male but separate quickly as the typical feminine response is not evoked by the male. (Mating type 5): When newly emerged females are placed along with previously mated males, the males are not aggressive and therefore the females move around the males. Mating is rarely attempted. In mating types 3, 4 and 5, frequency of successful mating is comparatively less (Table 1).

TABLE 1

EFFECT OF AGE ON MATING RESPONSE

Mating type	Number of copula pairs	Number of mating attempts	% of successful mating
1	10	35	86
2	15	50	80
3	15	43	50
4	15	45	55
5	10	30	33

*Mating Competition and Aggression when one sex is predominant* (Mating type 6):

When few males are placed along with several females, normal mating similar to mating type 1 is observed, the females without mates wander around and do not disturb the other pairs engaged in courtship and copulation.

(Mating type 7): When males predominate in a colony of few females, the males without mates often disturb the copula pairs. Invariably the disturbing male persists by drumming on the mating female or rubbing the foretarsi of the female, but such female never responds. If the disturbance persists, then the female carries the male to a more isolated place. Occasionally the disturbing male is allowed to rest in between the mating pair (Fig. 6). In such cases the mating male raises its ventral side to accommodate the intruding male, the position of the mating male under such situation become almost perpendicular to the female. The intruder may thus rest for more than an hour — this type of unusual three in a mating position is also seen in the field frequently.

FIELD OBSERVATIONS

The ashweevil, *M. maculosus* lives and reproduces throughout the year in South India. They are abundant in the field during winter months, October to January. During this period mating is quite common. Newly emerged adults are sexually not active and require a maturation period. Hence mating is initiated only after 2-3 days of adult emergence. The males live 25-30 days while the females live for 30-45 days. During the entire adult period, females mate only 4-5 times, while the males mate more frequently. Receptivity in females decreases with age and previous mating attempts. The cool part of the day (05.00-09.00 hrs.) is preferred for mating in the field. In the laboratory conditions they mate throughout the day. Halfpter and Yrma (op. cit.) recorded noon time to be the most favoured time for mating in *Phanaeus* (Scarabaeidae). During hotter times, the adults rest between the bracts and bolls or underneath the foliage.

## DISCUSSION

Sexual identification is apparently visual. Morphologically the male and female look similar except for the size, the female is considerably larger than the male. Similarly vision plays the major role in the sex identification in *Pantorlytes szentivanyi* (Curculionidae) (Hassen 1975). The entire courtship is very brief and never lasts more than 2 minutes. Courtship is initiated by males only. When the male sights the female, he swings his antennae over the female. Similarly brief series of antennal contacts were recorded in *Microlarinus lareynii* (Curculionidae) (Kirkland and Goeden, op. cit.). Antennation detains the responding female, otherwise the unwilling female runs away swiftly. When the female stops, the male rubs with his fore legs the fore tarsi and pronotum of the female, which further stimulates the female. Engelmann (1970) refers this kind of tactile stimulus during courtship and mating in many species of Coleoptera. Apart from tactile stimulation, Selander and Jansson (op. cit.) reported stridulation in males to be associated with the mating behaviour of the large pine weevil *Hylobius abietis*. Once the genital connection is secured the male rides on the female, fully supported by her body and remains motionless with his antennae erect or bent. This is the most dominant feature during mating in *M. maculosus* and Pinto (op. cit.) also records such behaviour in blister beetles of the subtribe Eupomphina (Meloidae). Whenever the intruder persists, the agitated male rubs the pronotum of the female with his fore legs, compelling the female to move to suitable isolated sites. While mating is in progress, the fore and mid legs of the male grip the lateral sides of the female's abdomen just over the mid and hind legs and the hind legs of the male hold the genital segments of the

female. The tibiae, tarsi and claws of the fore and mid legs and tibial tips of the hind legs of the male are engaged in holding the female. The tarsi and claws of the hind legs of the male are kept bent and do not hold the female when at rest. Only when the female moves rapidly these organs are engaged in holding the venter of the abdominal tip of the female. In the mating position the female spreads all the three pairs of her legs on the resting surface. When copulation is intensive the foretarsi of the male are firmly placed on the elytra of the female and the male is almost vertical to the female. The percentage of successful matings decrease when aged and previously mated adults were tested (Table 1). Fresh and unmated females are invariably receptive to mating, with 80% of successful mating (mating type 2—Table 1). Only 50% of successful mating resulted with previously mated females (mating type 3). The percentage of successful mating is lowest (33%) when mated and aged males were tried with virgin females (mating type 5). Just mated females and those with fully matured eggs (confirmed by dissection of ovaries) never allow copulation. When the female is decidedly not receptive, the male does not persist in establishing genital connection but climbs over the female (Fig. 5) and sits for a considerably time and then lifts the genital segments in order to secure genital connection. However the male's aedeagus is only released when the female responds by opening the genital aperture. Unmated males, when coupled with newly emerged females, become sexually more excited when the newly emerged females do not respond to the repeated mating attempts of the males (mating types 2 and 6) indicating more sexual drive in the males than in the females. It also appears that the females do not become violent but the males become aggressive if denied an opportunity for mating.